

silicon containing photoresist to provide a high-resolution pattern to be transferred into an underlying layer. In view of *Babich* and *Lin*, the Examiner concluded that it would have been obvious to one of ordinary skill in the art to incorporate the silicon containing photoresist of *Lin* into the amorphous carbon scheme of *Babich*. Applicants traverse the rejection and respectfully submit that the cited combination of references fails to teach or suggest each and every element recited within Applicants' claims.

Babich is generally directed to depositing a hydrogenated amorphous carbon film via sputter deposition techniques. *Lin* generally teaches the use of a silicon containing photo resist material (see Column 10, lines 25 – 30). However, neither *Babich* nor *Lin* teach or suggest depositing a silicon containing photoresist layer on top of an amorphous carbon layer, and then forming an insitu resist layer hard mask in an outer portion of the photoresist layer during a process of etching through the amorphous carbon layer, as recited in Applicants' independent claims 1, 17, and 36. Further, neither *Babich* nor *Lin* provide any teaching or suggestion to combine the teachings of the individual references, nor do either of the references contemplate the advantages provided by using a silicon containing photoresist material in an amorphous carbon mask scheme, i.e., the formation of an in situ hard mask in the photoresist layer. Therefore, inasmuch as the cited combination of references fails to teach or suggest each and every limitation recited within Applicants' independent claims 1, 17, and 36, reconsideration of the rejection of claims 1 and 36, along with dependent claims 2 – 6, and 37 – 44 is respectfully requested.

Claims 10 – 14, 16 – 26 and 30 – 35 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *Babich* in view of *Lin* and *Mitani* (U.S. Patent No. 6,191,463). The Examiner takes the position that *Mitani* teaches the deposition of a silicon oxide or nitride layer on the substrate prior to the deposition of the amorphous carbon layer, and therefore, concludes that the subject matter recited in claims 10 – 14, 16 – 26 and 30 – 35 would have been obvious to one of ordinary skill in the art in view of the cited combination of references. Applicants traverse the rejection and respectfully submit that the cited combination of references fails to teach or suggest each of the limitations recited in claims 10 – 14, 16 – 26 and 30 – 35.

Prior to addressing the substantive portion of the rejection, Applicants note that each of claims 10 – 14, 16 – 26 and 30 – 35 depend from either claim 1 or 17, both which have been argued as allowable above. Therefore, Applicants submit that each of claims 10 – 14, 16 – 26, and 30 – 35 are allowable as a result of being dependent upon an allowable base claim. As such, reconsideration and withdrawal of the rejection of claims 10 – 14, 16 – 26 and 30 – 35 is respectfully requested.

Aside from claims 10 – 14, 16 – 26 and 30 – 35 being allowable as a result of being dependent upon an allowable base claim, Applicants further submit that *Mitani* teaches a method for improving an insulating film deposited on a semiconductor device. The improved insulating layer is generally disclosed as a silicon oxide or silicon nitride film deposited via a chemical vapor deposition process. However, *Mitani* does not teach or suggest depositing a material layer on a substrate via CVD prior to depositing an amorphous carbon layer, as recited in claim 10. Further, *Mitani* does not teach or suggest using a photo resist having between about 3% and about 30% of silicon therein to form an insitu hard mask in the photo resist layer during an etch process, as recited in claims 11 – 14, 16 – 26, and 30 – 35. Therefore, Applicants submit that the cited references, either alone or in combination, fail to teach, show, or suggest each limitation recited in claims 10 – 14, 16 – 26 and 30 – 35. As such, reconsideration of the rejection of claims 10 – 14, 16 – 26 and 30 – 35 is respectfully requested.

Claims 8, 9, 43, and 44 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *Babich* in view of *Lin*, as discussed above, further in view of *Yang* (U.S. Patent No. 6,165,695). The Examiner takes the position that *Babich* and *Lin* fail to teach the use of a layer of photoresist having thickness of less than 500 angstroms. However, the Examiner cites to *Yang* as disclosing a method of manufacturing a semiconductor device, wherein the method uses an ultra-thin layer of photoresist having a thickness of between 50 and 2000 angstroms. Applicants traverse the rejection and respectfully submit that the cited combination of references fails to teach or suggest each of the limitations recited in claims 8, 9, 43, and 44.

Babich and *Lin* are discussed above. *Yang* teaches a thin resist layer with an amorphous silicon hard mask to be used for an etch application. The resist layer is disclosed as having a thickness within the range of 50 angstroms to 2000 angstroms

(Column 3, lines 25 – 26). However, Yang does not teach or suggest the use of a silicon containing photoresist material on top of an amorphous carbon film, wherein the silicon containing photoresist material forms an insitu hard mask in an outer portion thereof when exposed to an etchant configured to etch into the amorphous carbon layer, as recited in independent claims 1, 17, and 36. Therefore, inasmuch as each of claims 8, 9, 43, and 44 depend from one of claims 1, 17, and 36, Applicants submit that the cited combination of references, either alone or in combination, fails to teach, show, or suggest each and every limitation recited in claims 8, 9, 43, and 44. As such, reconsideration of the rejection of claims 8, 9, 43, and 44 over the cited art is respectfully requested.

Claims 27 and 28 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *Babich* in view of *Lin* and *Mitani*, further in view of *Yang*. The Examiner takes the position that the cited combination of references teaches a resist layer hard mask having a thickness of between about 75 angstroms and about 200 angstroms. Applicants traverse the rejection and respectfully submit that the cited combination of references fails to teach, show, or suggest each and every element recited in claims 27 and 28.

Each of the cited references are discussed above, and as noted above, Applicants submit that the cited combination of references fails to teach, show, or suggest using a silicon containing photoresist over an amorphous carbon layer, and etching into the amorphous carbon layer with an oxygen based etchant in a manner that causes an insitu resist layer hard mask to be formed in the resist layer. These limitations are recited in independent claim 17, the independent claim from which claims 27 and 28 depend, and therefore, claims 27 and 28 inherently incorporate each of these limitations therein. Further, the cited combination of references fails to teach or suggest that the thickness of an insitu resist layer hard mask may be between about 75 angstroms and about 200 angstroms, as recited in claims 27 and 28 as the cited combination of references does not even contemplate the insitu hardmask of the invention. Therefore, Applicants submit that the cited combination of references fails to teach, show, or suggest each and every limitation recited within claims 27 and 28, as well as each and every limitation recited in independent claim 17, the independent claim

from which each of claims 27 and 28 depend. As such, reconsideration of the rejection of claims 27 and 28 is respectfully requested.

Claim 15 stands rejected under 35 U.S.C. §103(a) as being unpatentable over *Babich* in view of *Lin*, further in view of *Sobczak* (U.S. Patent No. 4,576,834). Applicants traverse the rejection and respectfully submit the claim 15 recites subject matter that is neither disclosed, taught, nor suggested by the cited combination of references.

Babich and *Lin* are discussed above. *Sobczak* teaches a method of forming a device utilizing an oxygen based RIE process, which generally operates to remove a portion of a photoresist layer, along with one or more underlying oxide and/or nitride layers. However, neither *Sobczak*, *Babich*, nor *Lin* teach, show, or suggest forming a patterned amorphous carbon layer in a multilayer stack, wherein the pattern formation includes utilizing a silicon containing photoresist in conjunction with an oxygen based etching process, so that the etching process may be used to form an insitu hard mask layer within a photoresist layer deposited above the amorphous carbon layer, as recited in claim 1, the independent claim from which claim 15 depends. Therefore, Applicants submit that the cited combination of references fails to teach or suggest each and every limitation recited within claim 15, and as a result thereof, Applicants request reconsideration and withdrawal of the rejection of claim 15 over the cited art.

Claim 29 stands rejected under 35 U.S.C. §103(a) as being unpatentable over *Babich* in view of *Lin*, *Mitani*, and *Sobczak*. Applicants traverse the rejection and respectfully submit the claim 29 recites subject matter that is neither disclosed, taught, nor suggested by the cited combination of references.

Each of the references cited in support of the rejection have been discussed above. Claim 29 depends from claim 17, which recites a method for patterning a material layer in a multilayer stack, wherein the method includes depositing a silicon containing photoresist layer over an amorphous carbon layer. The photo resist layer is patterned, and then the amorphous carbon is etched away while an insitu hard mask layer is simultaneously formed over the top of the photoresist layer. The cited combination of references, either alone or in combination, fail to teach, show, or suggest forming an insitu hardmask in the resist layer during an etch step as discussed above.

Therefore, Applicants submit that the cited references fail to teach, show, or suggest each and every limitation recited in claim 29. As such reconsideration of the rejection of claim 29 is respectfully requested.

The prior art made of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, it is believed that a detailed discussion of the secondary references is not deemed necessary for a full and complete response to this office action. Accordingly, allowance of the claims is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed aspects of the invention. Having addressed all issues set out in the office action, applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



N. Alexander Nolte
Registration No. 45,689
MOSER, PATTERSON & SHERIDAN, L.L.P.
3040 Post Oak Blvd., Suite 1500
Houston, TX 77056
Telephone: (713) 623-4844
Facsimile: (713) 623-4846
Attorney for Applicant(s)